

SOMATIC CHROMOSOME NUMBERS FOR SOME NORTH AMERICAN SPECIES OF *JUNCUS* L.

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The genus *Juncus* is worldwide in distribution and comprises something over 200 species. Chromosome numbers have been determined for less than half the species and, while chromosome numbers alone cannot serve to distinguish species, it seems likely that knowledge of chromosome numbers will serve in some instances to supplement taxonomic judgments made largely on morphological grounds.

MATERIALS AND METHODS

All chromosome counts reported here were obtained from squashes of root tips from plants in the field or from plants maintained in moist sand in the greenhouse. Excised root tips were pretreated for one hour in 0.1% colchicine, fixed in 3:1 absolute ethanol: glacial acetic acid, hydrolyzed for ten minutes at 60°C in *N* HCl, and stained in Schiff's Reagent. With this treatment, the chromosomes in all species were between one and 1.5 micrometers in length, as measured with an ocular micrometer under oil immersion. Because of the size of the chromosomes, no observations could be made as to centromere position, satellites, or secondary constrictions. The counts were repeatedly verified in several different root tips from the population. Voucher specimens with a drawing of the chromosomes were prepared. A complete set of vouchers is deposited here at the Herbarium, University of Wisconsin-Oshkosh, and some duplicate vouchers have been distributed elsewhere.

We had intended at the outset to fix the root tips without pretreatment, so that our findings would be comparable to those of Snogerup (1963), who made many observations on relative sizes of chromosomes within the genome of a species. However, we encountered so many difficulties in

getting countable metaphase figures that we resorted to colchicine pretreatment, which shortens chromosomes and makes it impossible for us to characterize the chromosomes with respect to relative lengths.

OBSERVATIONS

We adopt here, without comment, the sectional designations used by Snogerup (1963) and largely by Fernald (1950).

I. Section Poiophylli:

1. **J. bufonius** L. WISCONSIN, WINNEBAGO CO.: along south side of RR tracks at crossing on state route 110, Algoma Blvd., at the N city limits of Oshkosh, sect. 10, T18N, R16E. *Harriman* 9207. 10 July, 1973. $2n = \text{ca. } 108$. An array of chromosome numbers has been reported for this species (see, e.g., Löve & Löve, 1961). It remains to be demonstrated whether morphological correlations with these various chromosome numbers exist. Because this annual species regularly sets seeds, despite the high chromosome numbers that have been demonstrated in some populations, and because these higher polyploids are doubtless autopolyploids, it may well be that at least some populations of the species are agamospermous. The observations of Marie-Victorin & Rouleau (1964) on pollination in this species do not, of course, preclude the possibility of agamospermy.

2. **J. compressus** Jacq. WISCONSIN, WINNEBAGO CO.: along grassy edge beneath U.S. 41 overpass at state route 21, on the south side of route 21 only, and on to the lawn at the Howard Johnson's, Oshkosh. *Harriman* 10186. 11 July, 1974. $2n = 44$. This count is in agreement with that reported in Snogerup (1963) and repeated in Nilsson & Snogerup (1971) and is the first report for this species from New World material; the report of $2n = 40$ (Holmen *in* Löve & Löve, 1961) has not been confirmed thus far.

This primarily Eurasian species is reported to range in North America (perhaps as an introduction) from Newfoundland and Nova Scotia to eastern Ontario. This is the first report of its occurrence in Wisconsin; duplicates of it have been distributed to WIS, UWM, MIL, MICH, NY, GH, IU, NHA, MIN, USFS, and elsewhere. The plants occur very densely by the hundreds, in sandy clay or clay alone, in full sun as well as in partial shade cast by the concrete overpass bridge. In aspect, they are a deep green-black color, not at all glaucous as characterized by Fernald (1950, p. 403). The plants were abundantly in fruit and readily identifiable in the treatments of Fernald (*op. cit.*), and those of Nilsson & Snogerup (1971, 1972). Dr. F. J. Hermann has kindly confirmed the identification, and has given permission to publish two further records for the species which considerably extend its heretofore known range: MONTANA, BEAVERHEAD CO.: marshy edge of roadside ditch, 9 miles south of Wisdom. *Hermann* 12484. September, 1955. (CA, MONT, US) and, COLORADO, WYOMING CO.: sedge meadow south of Spring Canyon, 5 miles southwest of Fort Collins. *Herman* 23841. 27 June, 1955. (COLO, NY, USFS). Dr. Askeell Löve has most helpfully called to my attention reports of *J. compressus* for Manitoba by Scoggan (1957).

J. dichotomus Ell. FLORIDA, ALACHUA CO.: grassy roadside, bottom of steep embankment, at a rest stop on northbound I-75, just south of its junction with state route 121. *Harriman* 8860. 20 April, 1973. $2n = 80$. A chromosome number for this species has not heretofore been published; species to which it is closely allied, e.g., *Juncus Dudleyi*, *J. Greenei*, and *J. interior*, likewise have $2n = 80$ (see above).

J. Dudleyi Wieg. WISCONSIN, WINNEBAGO CO.: sandstone at junction of state route 116 and county trunk E, section 19, T18N, R15E. *Redmond* 139. 2 July, 1971. $2n = 80$. This is the first report of a number for this species.

5. **J. Greenei** Oakes & Tuckerm. WISCONSIN, WAUSHARA CO.: very abundant in a mushy roadside ditch at the junction of county trunk N and state route 21 at the east limits of Redgranite, section 17, T18N, R12E. *Harriman* 9258. 17 July, 1973. $2n = 80$, the first number to be published for this species.

6. **J. interior** Wieg. WISCONSIN, ADAMS CO.: open, very dry sands, on a sand lane that dead-ends at Peten Flowage, west ca. 100 yds. off county trunk Z at Arc Lane, section 15, T20N, R5E. *Harriman* 10095. 29 July, 1974. $2n = 80$, the first report of a chromosome number for this species. The status of this species is a matter of some debate; Correll & Johnston (1970) suggest that it is probably conspecific with *Juncus dichotomus*; although they do not reduce it to the synonymy of that species, the chromosome numbers reported here would permit such a decision. It is obvious that *J. interior* is closely related to *J. tenuis* as well; indeed, the two are commonly mislabeled in herbaria. However, despite the strong morphological similarity between these two taxa, the chromosome numbers of North American populations thus far studied (all below for *J. tenuis*) would not support reducing *J. interior* to the synonymy of *J. tenuis*.

7. **J. tenuis** Willd. WISCONSIN, WINNEBAGO CO.: sand dunes at junction of state route 116 and county trunk E, section 19, T18N, R15E. *Redmond* 140. 2 July, 1971. $2n = 80$. This determination agrees with that of Taylor & Muller (1968). The reports of $2n = 30$ (Löve & Löve, 1948) and $2n = 32$ (Sasaki, 1937) suggest an aneuploid reductoid series in this very widespread species. The report of $2n = 84$ (Nilsson & Snogerup, 1971), presumably from Scandinavian plants, is anomalous at present, but suggests the existence of various chromosomal races which may be correlated with morphological characters.

II. Section Genuini:

J. balticus Willd. WISCONSIN, WAUSHARA CO.: margins of Plainfield Lake, section 18, T20N, R9E. *Redmond* 85. 22 July, 1971. $2n = 80$, apparently the first report for a New World population of this widespread species. Published reports include $2n = 40$ (Löve & Löve, 1956) and $2n = 80$ (Löve & Löve, 1961). Since there are apparently both diploid and (auto) polyploid races, detailed cytotaxonomical investigation is warranted here.

J. effusus L. WISCONSIN, MARQUETTE CO.: Germania Marsh, section 12, T16N, R10E, in moist roadside sands. *Redmond* 115. 26 September, 1970. $2n = 40$. The same number has been reported by Löve & Löve (1961), but Taylor & Mulligan (1968) report $n = 40$ for var. *gracilis* Hook. The voucher for the present determination will key to var. *Pylaei* (LaHarpe) Fern. & Wieg., in Fernald's key (1950). However, we agree with Voss (1972) that, "While the extremes of variation are well marked, too many intermediate plants occur to make it useful to attempt to distinguish varieties here." It may be that extensive chromosome counting over a considerable portion of the range of this species will reveal chromosomal differences among the morphological "varieties" that will lead to a more workable delimitation of infraspecific categories in this species. Snogerup (1963) reports $2n = 42$ for a number of Swedish populations of this species. It appears that both euploidy (from diploid to tetraploid levels) and aneuploidy (at the diploid level) are at work in this species; it remains to be demonstrated whether the complex variability of this species can be correlated with chromosome numbers.

10. **J. filiformis** L. WISCONSIN, WOOD CO.: abundant, hundreds of clumps, in the second bog to the east of the pump house, in the Getzin cranberry bog, east off county trunk Z, $\frac{1}{2}$ mile south of the junction of Z and state route 73, section 14, R5E, T21N. *Harriman* 10169. 29 June, 1974. $2n = 70$. Previous reports of chromosome numbers

for this species include $2n = 40$ (Löve & Löve, 1956) and $2n = c. 80$ (Jørgensen et al., 1958). The report here of $2n = 70$ is anomalous in a genus where diploid numbers are overwhelmingly 40 and 80, but we determined it repeatedly from many root tips in the population cited. Like so many other species of *Juncus*, this species appears to be evolving both by euploidy and aneuploidy, but in this instance with the aneuploidy occurring at the tetraploid level (from 80 down to 70) rather than at the diploid level. To judge from the manual treatments of this species, there is relatively little variability and apparently little or no taxonomic confusion surrounding this species, despite the various chromosome numbers.

11. *J. inflexus* L. MICHIGAN, HOUGHTON CO.: roadside and in the ditch, beside southbound U.S. 41, ca. 50 yds inside the Hancock city limits, and 100 yds. downhill from the scenic overlook. *Harriman* 9682. 2 September, 1973. $2n = 40$, the first report for a New World population of this species; the number is in agreement with other published reports for the species (Löve & Löve, 1961; Snogerup, 1963).

III. Section Graminifolii:

12. *J. biflorus* Ell. MISSOURI, WARREN CO.: along a drainage course from artificial ponds on the Hartman farm on state route 47, just south of its junction with county highway CC, south of Warrenton. *Harriman* 9349. 11 August, 1973. $2n = 40$, apparently the first number to be published for this species.

13. *J. marginatus* Rostk. WISCONSIN, MARQUETTE CO.: in black muck, edge of a small puddle, off Duck Creek Avenue, section 26, R10E, T17N. *Redmond* 382. 11 August, 1971. $2n = 40$; Snogerup (1963) reported $2n = 38$, his voucher from near Washington, D.C. These two species, *Juncus biflorus* and *J. marginatus*, are clearly very

closely related, together with *J. Longii* Fern., whose chromosome number is unknown. Snogerup argues that both *J. biflorus* and *J. Longii* should be reduced to the synonymy of *J. marginatus*; the known chromosome numbers lend no support to maintaining them as distinct species. Nonetheless, all current manuals of eastern North American plants maintain these as distinct entities.

IV. Section Septati:

14. **J. acuminatus** Michx. WISCONSIN, WAUSHARA CO.: wet sand at the very edge of the water, north shore of Taylor Lake, SE $\frac{1}{4}$ section 29, R12E, T19N. *Harriman* 10319. 27 July, 1974. $2n = 40$. And: MISSOURI, WARREN CO.: around artificial ponds, in heavy clay, on the Hartman farm on state route 47, just south of its junction with county highway CC, south of Warrenton. *Harriman* 9345. 11 August, 1973. $2n = 40$. These are apparently the first reports of a chromosome number for this species.

15. **J. alpinus** Vill. WISCONSIN, GREEN LAKE CO.: marsh beyond the east end of Water Street, in the village of Princeton. *Harriman* 2579. 3 October, 1967. $2n = 40$, apparently the first determination for this species from continental North America; the same number has been reported for Greenland material (Jørgensen et al., 1958), European material (Löve & Löve, 1961), and Queen Charlotte Islands plants (Taylor & Mulligan, 1968). A count of $2n = 80$ for subsp. *nodulosus* (Wahlenb.) Hulten by Vaarma et al. (*in* Löve & Löve, 1948) again demonstrates the occurrence of (auto)polyploidy in various Junci.

16. **J. articulatus** L. MICHIGAN, SCHOOLCRAFT CO.: roadside marshy ditch, in black, peaty muck, at entrance to Seney National Wildlife Refuge, on state route 77, section 16, Germfask Township. *Harriman* 10486. 24 August, 1974. $2n = 80$, again an apparent first determination for this species from continental North America. The same

chromosome number has been determined for the species elsewhere (Löve & Löve, 1961; Taylor & Mulligan, 1968, where it is asserted that the reports of $2n = \text{ca. } 60$ and $n = \text{ca. } 30$ by Wulff (1937 and 1938, respectively) should be referred to another species.) This species is somewhat confluent with *J. alpinus*; the characters given in Hitchcock et al. (1969) serve best to distinguish the two.

17. ***J. brachycarpus*** Engelm. MISSOURI, MONTGOMERY CO.: abundant in low, abandoned, waste edge of a soybean field on the Welch farm, beside I-70, at the north edge of the village of Jonesburg. *Harriman* 10455. 6 August, 1974. $2n = 44$, the first report for this species. Like *J. compressus*, where both $2n = 40$ and $2n = 44$ have been reported, *J. brachycarpus* may prove to be made up of more than one chromosomal race, when more populations from throughout its extensive range have been sampled.

18. ***J. brachycephalus*** (Engelm.) Buch. WISCONSIN, WAUSHARA CO.: in marly muck at a boat landing on Marl Lake, section 23, T19N, R9E. *Harriman* 7589. 28 August, 1971. $2n = 80$, the first report for this species.

19. ***J. brevicaudatus*** (Engelm.) Fern. WISCONSIN, PORTAGE CO.: in sand pits beside U.S. 51 at the north city limits of Stevens Point, section 18, T24N, R8E. *Redmond* 245. 13 July, 1971. $2n = 80$; this determination confirms the reports of $2n = 80$ by Löve & Löve (1966), Löve & Ritchie (1966), and Snogerup (1963).

20. ***J. canadensis*** J. Gay in La Harpe. WISCONSIN, MARQUETTE CO.: sandy, wet roadside ditch in Germania Marsh, section 12, T16N, R10E. *Redmond* 114. 26 September, 1970. $2n = 80$; the same number has been determined for this species by Snogerup (1963). It is to be expected that these three species, *Juncus brachycephalus*, *J. brevicaudatus*, and *J. canadensis*, which are somewhat confluent morphologically, would all have the same chromosome number.

. **J. nodosus** L. WISCONSIN, GREEN LAKE CO.: at edge of a drainage ditch in a marsh east beyond the end of East Water Street, near the airport, in Princeton. *Harriman* 7478. 3 October, 1967. $2n = 40$, apparently the first report of a chromosome number for this species.

. **J. pelocarpus** E. Meyer. WISCONSIN, MARQUETTE CO.: at very edge of water in wet sand, on Tuttle Lake at Camp Indian Sands, section 22, T17N, R10E. *Redmond* 411. 11 August, 1971. $2n = 40$, apparently the first report of a chromosome number for the species.

. **J. rugulosus** Engelm. CALIFORNIA, LOS ANGELES CO.: at edge of ditch and side of small creek along rough gravel portion of San Francisquito Canyon Road, 15 miles north of Lancaster, at possibly 1500 feet elevation, or lower; rhizomes branched and knotted. *Parfitt* 1060. 27 July, 1974. $2n = 40$, the first report for this species.

. **J. Torreyi** Cov. WISCONSIN, WINNEBAGO CO.: very abundant in marshy area between Soo Line and C&NW RR tracks, ca. 100 yds. north of the junction of county roads Y and A, section 30, R17E, T19N. *Harriman* 2574. 14 September, 1967. $2n = 40$; Snogerup (1963) likewise determined the same number for plants from eastern Canada. This species is similar to *J. nodosus* L., but almost always readily separable; we had expected to find *J. Torreyi* to be a polyploid derivative of *J. nodosus*, since *J. Torreyi* differs primarily in being larger in all its parts than *J. nodosus*.

V. Section Ensifolii

. **J. ensifolius** Wikstr. WISCONSIN, ASHLAND CO.: at roadside ditch, in standing water over a substrate of granite chips and mud, on the east side of state route 13, exactly 0.5 mile south of the Mellen city limits, section 6, T44N, R2W, very abundant. *Harriman* 7484. 16 August, 1971. $2n = 40$; this determination agrees with the numerous reports of Taylor & Mulligan (1968) and Snogerup

(1963). The occurrence of this species in Wisconsin deserves comment: the population was discovered by Hugh Iltis at WIS and he very kindly shared his discovery with us; its establishment in this single locality in Wisconsin is unexplained. The population comprised several hundred of flowering stems, all abundantly in fruit and producing apparently viable seeds; since similar moist habitats occur throughout much of the northcentral United States and adjacent Canada, the species will doubtless be found to occupy a much more extensive range in eastern North America in the future. (The species is mentioned in Marin Victorin & Rouleau (1964) as occurring in Quebec.)

SUMMARY OF SOMATIC CHROMOSOME NUMBERS REPORTED
HERE, AND BASE NUMBERS IN THE SECTIONS OF JUNCUS

Sect. Genuini (Buchenau) Vierhapper : $x = 20$ and 2

1. *J. balticus* 80
2. *J. effusus* 40
3. *J. inflexus* 40

These numbers support Snogerup's designation (1963) of this section as having $x = 20$.

Sect. Poiophylli (Buchenau) Vierhapper : $x = 20, 22$
and 22

1. *J. bufonius* ca. 108
2. *J. compressus* 44
3. *J. dichotomus* 80
4. *J. Dudleyi* 80
5. *J. Greenei* 80
6. *J. interior* 80
7. *J. tenuis* 40

We ignore *J. bufonius* in calculating base numbers, since the numerous counts on this species fit into no definable pattern; the data reported here permit adding the base number 20 to this very diverse section of the genus.

Sect. Graminifolii (Buchenau) Vierhapper : $x = 19$
and 20

1. *J. marginatus* 40
2. *J. biflorus* 40

Snogerup (1963) calculated a base number of 19 for this section, based on his one count of $2n = 38$ for *J. marginatus*. The counts reported here establish a second base number for this section.

Sect. Septati (Buchenau) Vierhapper : $x = 20$ and 22

1. *J. acuminatus* 40
2. *J. alpinus* 40
3. *J. articulatus* 80
4. *J. brachycarpus* 44
5. *J. brachycephalus* 80
6. *J. brevicaudatus* 80
7. *J. canadensis* 80
8. *J. nodosus* 40
9. *J. pelocarpus* 40
10. *J. rugulosus* 40
11. *J. Torreyi* 40

The counts reported here generally support Snogerup's designation of base number in this section as $x = 20$; however, the count for *brachycarpus* now establishes a base number of $x = 22$ in this section as well.

Sect. Ensifolii Rydb. ex Snogerup : $x = 20$

1. *J. ensifolius* 40

The count reported here for a Wisconsin population of the species confirms this base number for the section.

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